

SUPPLEMENT.

The Mining Journal, RAILWAY AND COMMERCIAL GAZETTE:

FORMING A COMPLETE RECORD OF THE PROCEEDINGS OF ALL PUBLIC COMPANIES.

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Original Correspondence.

THE SCIENCE OF INVESTMENTS.

Capital and labour are the two forcing powers of society. Industry promotes progress and fosters prudent economy; integrity is the soul of commercial dealings, and rare is the instance when failure attends its observance; in business transactions confidence is of secondary moment only to capital and industry. The science of investments would prove of no importance to the possessor of wealth unless he made it a study of earnest and searching investigation. In order to form a correct appreciation of the value of any particular security intelligent enquiry and unbiased judgment must be brought to bear, and then a correct estimate of value can be arrived at. There are associated with all speculate enterprises men of reckless conduct, indifferent reputation, and lack of practical intelligence. Their advice is often tendered unsolicited; their language fluent, and their arguments unchallenged, most persuasive and conclusive. This class of market operators should be avoided by all requiring investors, for judgment is wanting there. What the hand is to the body speech is to the mind; useful beyond limit, open to the career of profitable culture, how often is the latter attribute profaned? Man who has in this age of progress effected such wonderful discoveries, and rendered them subservient to his will, and practically useful and profitable to his kind, is often unable in control that solitary member of his frame, the very position of which, increased and imprisoned by dental bars, shut up in darkness, and chained in its recess, shows that it is a prisoner, and ought to be brought the securities of continual discipline. We, therefore, suggest to our readers the following remarks for their observance:—

Take no notice of gratuitous advice to sell out of a good paying marketable property, and exchange or re-invest into a speculative, undetermined concern, of which you possess no personal knowledge, and of the merits of which you can form no estimate. The speculative brokers and dealers to whom I refer would with unblushing assurance recommend holders to sell or exchange every security they possess regardless of inherent merits, in order to foster their favourite schemes and concoctions. Italian bonds, paying 10 per cent. interest, are surely preferable to a mine or quarry on the inaccessible hills of Nevada. Turkish bonds, yielding 9 to 10 per cent., cannot be worse to hold than many a scheme loudly advocated, though unproven, at immense premiums upon the Stock Exchange of London, the members of which think more of accumulated dealings in stocks and shares than of the actual worth of that which they buy and sell. A market is all that they require. Frequent commissions and turns of prices alone engross their attention.

It was stated some months ago in Parliament that the annual income of the United Kingdom exceeded 850 million sterling—a sum far exceeding our national indebtedness, the costs of our entire fabric of railways, more than the outlay upon all our paying and profitable mines of iron, coal, copper, tin, and lead throughout the kingdom, or any other single branch of home industry to which reference can be made, excepting possibly steam and sailing ships combined. From a paper read by Mr. W. Taylor, F.R.S., in the Section of Economical Science, at the recent meeting of the British Association, in regard to the manual labour classes of England, Wales, and Scotland, that gentleman stated that the returns of the last census showed that the population of the United Kingdom numbered 31,817,108. The best class of skilled labourers numbered 1,178,000, who earned weekly from 28s. to 35s. each, amounting to 59,000,000s. annually. The second class, or lower skilled labourers, numbered 4,009,000, who earned weekly from 21s. to 25s., or a total annual income of 1,500,000s. The third class, unskilled and agricultural labourers, numbered 2,957,000, who were paid from 14s. to 20s. weekly, or, allowing for loss of time, an annual aggregate of 107,500,000s. We have three classes of skilled and agricultural labourers, numbering 8,144,000, that in the aggregate earned last year the enormous sum of 301,000,000s. It is a mainly pride, it is a boast worthy of all honour, for a man to say that his ten fingers are a mine of wealth, an inexhaustible store of riches. May such as cherish these idle thoughts of self-sustenance at all times enjoy the opportunity of exerting their skill, and command the highest possible return for their labour. Idleness is at the root of almost every misery. The eyes and ears are the mind's receivers, and the tongue should only be employed in diffusing the treasures received; on the contrary, the man who attempts with imperfect information to direct others will find his level, and the uninitiated who follow in his wake will, like with his monitor, soon find himself possessed of nothing other than a head without brains, a wit without judgment, a heart without honesty, and a purse without money.

There are, however, honourable and cautious brokers, with practical authorities and engineers, who can be consulted with every confidence in their *bona fides* and judgment in mining matters; but these gentlemen are usually distinct from, and aloof of, those promoters and schemers who float upon the surface of this market "undetermined" mines in the Brazils, America, Nevada, California, Mexico, New Zealand, Australia, India, Japan, and Italy. No one can question the authority of the Messrs. J. Taylor and Sons, but you would not have a hazardous opinion of them: their opinion would be founded on actual survey. These gentlemen have the management of numerous profitable mines in California, the Cape, Spain, Italy, France, and the best, without exception, in North and South Wales, and we cordially wish them continued success.

The panic and collapse of 1866 has effected many reforms and much good in the control and efficiency of our railways. A new system of perpetual debentures, instead of short-dated terminable ones, has effected practical retrenchment in commissions and economy of executive and professional labours. The money that has been called during the past four to six years has been expended in finishing partially completed branches and stations, whilst competitive opposition and distrust with, and of, neighbouring lines and their officials have to a great extent become extinguished. The time was when financial economists foretold the expenditure of 15,000,000s. annually would bankrupt the nation, but since those croakings that amount to life first drew breath in 1845, followed immediately by the panic of 1847. Dr. Lardner declared that a steamship could not cross the Atlantic. Brunel declared the screw-propeller an impossibility, on account of the friction of 60 revolutions per minute; "gal-

vanism and gas" served the humour of a great poet half a century ago to base a satirical essay; steamships, however, cross the Atlantic hourly, propelled by this impracticable screw; the galvanic battery whispers every minute intelligible words to the uttermost parts of the earth; and gas ranks almost foremost amongst our substantial social comforts and necessities. Of course now we shall have a period of progress and inflation, and of course we shall commit blunders and mistakes as usual. We shall have too many mines; the refuse of California will not be too dirty for our contact, even after the teaching of the "Agua Fria" and "Nouveau Monde;" we shall have too many paving and asphalt, and too many tramway companies, with telegraph companies *ad nauseam*; premiums indefinite, with discounts to follow; and, lastly, possibly something new, which has not yet seen the light.

Railways, however, are evidently displaying great expansion; their inherent capabilities are more severely tested, and their powers answer to the call; increased weekly revenue; lessened cost of maintenance of way and plant and reduced costs of working; improved and economised systems of finances, more practical supervision and control by the directors and heads of the executive over the whole staff of the employees, with a growing desire on the part of the public for locomotion and excursions of pleasure; and, lastly, increased weekly returns, and a bright future consequent on healthy trade and expanding commerce, we may regard our chief railways as sound in core and progressive in perspective.

The phenomena of mineral deposits, and the light thrown upon the subject through the aid of the arts and sciences render mining pursuits and successful results far more certain of late years than formerly. The concentration of copper ores at the Devon Great Consols is well defined upon material and geological principles, whilst the absence of mineral in paying quantities in the mines standing both to the east and to the west is clearly to be traced to the action of natural principles in direct opposition to those so active in the collection of ores at the Devon Great Consols. The junction of lodes in depth, and also in their passage eastward, when traversed by commanding north and south cross-courses or magnetic currents, is most important, and when the rock formation is highly crystallised paying deposits of ore are certain to be found. The same may be said of the great centre of mineral attraction surrounding the Carn Brea and Carnmarth hills.

The best mines in Cornwall 30 years ago were situate in this district, and the best that are now afloat in "the county" are still to be found there: 10,500s. quarterly is a dividend received from Tincroft, and, to the best of my knowledge, the Van only pays 9000s.; yet the market value of the former is 318,000s., against 810,000s. for the latter. It is well to embark into a fancy property at par, and realise at a brilliant premium in the full bloom of success. Still, as I suffer somewhat from "dyspepsia," it would prove more healthy and satisfactory to me to invest for "steaks and chops" out of Tincroft than to any fancy effervescent "viands" conserved on the tops of the Montgomeryshire hills.

Again, the concentration of ores at the Lisburne Mines is clearly defined, and is traceable to natural laws and natural recognisable phenomena. The mines to the east and west do not possess these essential qualities, and, with very exceptional cases, no paying deposits of lead ores have been discovered. In the next place, a map will establish the fact that nearly all the paying mines in Cardiganshire and Montgomeryshire stand in the same north and south parallel or magnetic current. Stretching even from the Dyliffe to the Cwm-yatwith, in this parallelogram, we have the Van, Bwlch Consols, Goginan, East Darren, South Darren, Plynlimmon, Nant-y-Iago, and almost every other mine of note in the two counties. The Llangynog Mine has been one of the most startling prizes of Welsh mining, the Earl of Powis family having received no less a sum than 1,600,000s. from royalties alone, whilst many a family of repute and house of stable commercial standing have sprung from the vast dividends received by the shareholders. To the east of this mine, and subject to the action of north and south cross-courses, or magnetic currents, and in a rock formation highly crystallised with paying deposits of mineral already discovered, stands the East Llangynog Mine, shares in which are marketable at 3s. each, with the promise of the first dividend from actual gains in November next.

It is to such districts as those referred to that investors in mining shares should turn their attention. It is true that the shares are not at all times in demand upon the London share market, and fortunately so for the interests of the *bona fide* and permanent holder, too, for he has the satisfaction in most cases of receiving substantial and regular dividends without the mortification of seeing his property manipulated and changed in character, tone, and value, every hour in the day in order to conserve the interests and to promote the gains of jobbers and brokers, who trade on the daily shifting credulity of a speculative gambling public.

THE MANUFACTURING INDUSTRY OF SCOTLAND.

In winding up the business of the British Association meetings held in Edinburgh, the members of the various sections visited places of interest to their associates. One of these interesting meetings included a short run by rail to—

THE ADDIEWELL PARAFFIN OIL WORKS, WEST CALDER.

This excursion, chiefly promoted by members of the Chemical Section, left Edinburgh on Saturday in order to visit the well-known Addiewell Paraffin Oil Works. The party assembled at the Caledonian station at ten o'clock. The large extent of these works may be supposed from the fact that they cover an area of nearly 51 acres, and employ about 1500 workpeople. They were commenced only seven years ago, and now contain no less than 3540 retorts, capable of distilling more than 3000 tons of shale per week, and producing 120,000 gallons of crude oil, which yields 50,000 to 60,000 gallons of burning oil, in addition to about 12 tons of refined paraffin oil and a large quantity of heavy lubricating oil. From the ammoniacal water several tons of ammonia are produced weekly. The party were first shown the retorts where the first process in the manipulation of the shale is carried on—its distillation. Next they were conducted to furnaces where the only fuel used was the soluble incondensable gas; then shown the ammoniacal water from which the sulphate of ammonia is extracted, and the paraffin oil in its crude state. The departments where the refining processes are carried on were next visited. Here were seen an apparatus for distilling the crude oil, and a chemical refinery where it is treated with sulphuric

acid. Then the distilling-boilers, where the oil is separated from the ammoniacal water, and afterwards acted on by chemical substances, were visited. The sulphuric acid manufactory was next inspected, and apparatus capable of manufacturing 36 tons of pyrites per week. These substances are manufactured only for the use of the company in refining the oil. Kirk's refrigerating machine was also seen in motion, where, by the compression and subsequent expansion of the air, the brine is cooled which is used for cooling the heavy oil from which the solid paraffin is made. The processes of making paraffine and purifying it till it exactly resembles newly-cut blocks of ice, were also seen; and, lastly, the formation of this purified paraffin into the candles. About 500 tons of candles are here manufactured in the year. The company did not visit the shale pits, which number 10 or 12, and are in close proximity to the works.

NEW SURVEYING INSTRUMENTS.

Much attention has recently been drawn to a new form of instrument, which may be seen in Div. III. at the London International Exhibition. It is intended for general surveying, and from the inspection of it practical men are inclined to believe that it is very likely to supersede the ordinary kind of instruments employed for such purposes. It is the joint invention of Mr. H. D. HOSKOLD, of Cinderford, mining engineer, and Mr. J. E. WINSPEAR, of Hull, optician and mathematical instrument maker, and they have designated it by the name of "Angleometer." It is particularly designed for measuring angles in the field and underground, similar to a theodolite, but in consequence of its peculiar construction it is not liable to the same amount of derangement and imperfection as that instrument—indeed, it will be found vastly superior both in point of construction, working, and occupies much less space. The instrument when made with a divided limb of 5 in. diameter is only 6½ in. in height, and, moreover, it is mounted with a telescope 10½ in. in length, of high optical power, and is made to revolve vertically, and thus becomes a transit instrument of great power and capability, either for extensive surveying on the surface or underground. Furthermore, its particular form renders it well adapted to be used as a zenith telescope for performing astronomical operations of importance, and for connecting underground surveys to those made on the surface directly, by means of the telescope without magnetic bearings, rendering it for that one operation alone a most valuable instrument, which doubtless will be duly appreciated by mining men.

The whole arrangement is new, although there are some parts in it common to all superior surveying instruments, such, for instance, as the silver limb for receiving the graduations, parallel levelling plates, clamp and tangent screws, &c. In surveying instruments of the best class hitherto constructed, such as the transit theodolite, equal power and capabilities can only be obtained by additional height, weight, and cumbersome of parts, the subject of so much objection to their general introduction for mining purposes. Thus, if we take a transit theodolite, with a limb of 5 in. diameter and a telescope of 10½ in. in length, as an example of comparison it will be seen that the telescope must be mounted upon Y's, which would render it over 12 in. in height at least, besides possessing the disadvantage of having the magnetic compass very much smaller than its own limb. Every additional inch to the height of an instrument of this class proves a disadvantage, simply because all the centres and bearings must be longer, and, consequently, vibration of the parts is increased. This is more especially so when exposed to currents of air and wind on the surface, which prove very destructive to observations. It is, therefore, desirable that all these points should be kept well in view while designing an instrument. We are pleased to observe that this has been practically realised in the designing and construction of the angleometer. It appears that the length of the telescope does not regulate the height of the instrument, as in the class of transits before referred to, for a small instrument of the new type may be made to carry a telescope of equal length and power with those of some of the larger instruments of the old type without additional height.

It will be seen, by referring to the instrument in the Exhibition, that the horizontal axis carrying the telescope and vertical circle is mounted close down on low bearings, not more than 1½ in. in height, on the upper vernier plate. These bearings, axes, and all other internal arrangements are covered up by a magnetic compass box of the same diameter as the angleometer's graduated limb. The needle of this instrument is constructed to carry a silver floating circle with verniers at each end, and it rests on a recess cut in the edge of the inner divided circle; it is thus prevented from rocking or vibrating unduly. The needle by its verniers is capable of reading magnetic bearings to single minutes, and will prove of very great service for determining the magnetic variation of the compass by observation. The divided limbs to horizontal and vertical circles are graduated to 20", but it is intended to divide a 5-in. limb to read to 10"; and by the high optical power applied in the telescope to render the instrument available for extensive operations, which were formerly performed with instruments of a large and more cumbersome nature. The telescope is fixed in a stout cylindrical ring, screwed to the one end of the axis a little larger than itself, and made to rotate in it horizontally, for the purpose of collimation. The vertical circle is constructed with a conical limb, and the graduations are put on its edge instead of, as usual, against the side of it; there is, consequently, greater facility provided for reading angles off from it. This vertical circle is attached to the opposite end of the telescope axis, and balances and moves with it; consequently, no vibration whatever exists in the instrument, not even when exposed to a rather severe blast of wind. At the eye end of the telescope there is a perforation, into which a piece of glass is fixed nearly opposite the cross-hairs, for the purpose of illuminating them by means of the flame of a candle or lamp when the instrument is used underground or at night. At other times a slide is turned, which effectually shuts out all light. There is also a micrometrical arrangement working mechanically in the eye end of the telescope, and communicating with two circular discs, about 1½ in. in diameter, outside the telescope, the circumference of which is divided into a certain number of equal parts, reading by means of verniers to the 10,000th part of an inch.

The object of this arrangement is for the purpose of ascertaining distances without direct measurement, which is performed in a very simple and accurate manner. There are two cross spirit-bubbles fixed below the needle in the compass-box, and on a level with the face of it they are adjusted by means of screws, which do not appear, and

cannot be damaged from exterior influences, as in theodolites. A longer and more sensitive spirit-bubble is attached to the vernier to vertical circle, which are dead fitted, but adjustments are provided for the bubble. A lever clamping apparatus is also attached to the vertical circle, which acts more effectually than clamping screws of the ordinary form. As angles are measured from the side and not from the centre of the instrument special station staffs are provided, which in practice works out in the same manner as though all the angles were measured from the centre of the instrument. Lamps on a similar principle are provided for underground work. The inventors of the angleometer propose to apply its principles to all and every kind of surveying instruments.

It has been applied by them to an ordinary miners' dial, one of which may be seen in the London International Exhibition, and it appears to be an excellent little instrument for the purpose for which it is intended. It has plain sights at one side of the compass-box, screwed to an horizontal axis passing through low bearings, as previously mentioned in the angleometer. To the other end of this axis a semi-circle is attached, and graduated on silver to read to 3'. It will be observed on examination that these plain sights may be made to perform an entire revolution vertically, carrying with it the horizontal axis and semi-circle at the other end of it; thus an angle may be observed at an high elevation or depression up to the vertical, in fact, or 90°, and in such position the sights does not interfere with reading the face of the compass. The best construction for dials hitherto has been that known as Hedley's dial, but when the concentric ring of it is raised, and the sight applied to an high angle, both the sights and ring carrying them tend to prevent dispatch in reading off bearings. All these disadvantages are avoided in the construction of the new dial referred to.

The plan of connecting lines without bearings can also be performed by this dial directly by its sights in awkward places underground, where the vertical distance of connection is not too far for marks to be seen distinctly through the blank sights. Bubbles are also fixed on a level with the compass face, so that vertical angles may be measured from the semi-circle to a considerable degree of accuracy. The proprietors of this invention have applied for a patent, which will very soon be completed.

It is understood that the same parties have another matter on hand, and in course of construction, which could not be completed in time for the Exhibition. This refers to a universal plotting scale, for laying down base and other lines to very great niceties.

CORNISH MINE ENGINE "DUTY."

SIR,—Our attention has been called to the letter signed "Engineer," in the Supplement to the Journal of June 17, on the duty of Sturk's engine at the Crenver and Abraham Mines. The data by which the duty is ascertained is obtained as follows:—The diameter of the plunger and drawing lifts attached to the engine, the depth from which the water is pumped, and the number of feet high it is lifted at each stroke of the engine are ascertained by measurement. The number of pounds lifted 1 foot high at each stroke of the engine is thus arrived at. An indicator fixed to the main beam of the engine, and to which no one has access but Mr. Lean, the reporter, registers the number of strokes performed, and the quantity of coal consumed is daily weighed off by a person appointed for that purpose.

Taking the engine instance, it will be seen on reference to the report that there are attached to this engine the following pumps:—

1 plunger-lift	35 fms. high.....	12 in. diameter.
3 plunger-lifts	126 fms. high.....	18 in. diameter.
1 plunger-lift	33 fms. high.....	17 in. diameter.
1 drawing-lift	33 fms. high.....	15 in. diameter.
1 drawing-lift	15 fms. high.....	13 in. diameter.

Which gives the total weight of water lifted at each stroke 133,660 lbs., and the length of stroke 10 ft. From May 9 to June 13 the engine worked 163,000 strokes, or 3·2 per minute. The consumption of coal during the same period was 2607 cwt. Then—

$$\frac{133,660 \times 10 \times 163,000}{2607} = 89,000,000 \text{ lbs.}$$

Lifted 1 ft. high by the consumption of 1 cwt. of coals, or 2·7 lbs. per horse-power per hour. JOHN HOCKING AND SON, Redruth, Aug. 11.

ASSURANCE OF MINERS.

SIR,—The introduction of the system of colliery assurance, which has several times been noticed during the past few weeks naturally reminds one of the late Mr. Herbert Mackworth's excellent paper on the Diseases of Miners, for I do not for one moment doubt that the Colliery Assurance Company will soon find, after the concern is in working order, that the system of assurance must be extended to all classes of miners, and to natural deaths amongst them as well as to accidental deaths. Of course a company assuring miners and colliers only would require a special table of rates, and to permit of such tables being made such data as those given by Mr. Mackworth are invaluable; not only were they collected with a thorough knowledge of what was required, but Mr. Mackworth's position as a Government Inspector of Mines gave him especial facilities for ensuring accuracy.

It was found that out of every 10,000 miners and colliers alive at the age of 15 no less than 1858 died before they attained 25 years; of these 632 came to violent deaths, and nearly an equal number by diseases of the heart, lungs, stomach, &c., likely to be aggravated by the nature of their employment. Of the 8142 remaining alive at 25 years 1476 died before attaining 35 years, 442 of these coming to violent deaths; in the succeeding 10 years 1368 died, including 415 who met with violent deaths. So that of the 10,000 first referred to only 5298 would remain alive at the age of 45, and of these 3806 were living at 55 years, 2207 at 65 years, 622 at 75 years, and 70 at 85 years. No miners over 75 years old were killed in the mines. Of the 10,000 alive at 15 years old, 2131 came to violent deaths; 80 died of small-pox; 1903 of cholera and diarrhoea; 773 of typhus; 3038 of phthisis and disease of the lungs; 335 of heart disease and dropsy; 354 of disease of stomach and liver; 82 of disease of kidneys; 19 of disease of joints; and 1281 of other causes, making up the 10,000.

Comparing these figures with those for ordinary lives, it seems that the premiums for assuring miners' lives would have to be increased by about 30 per cent.—that is, about 1s. per week premium would have to be paid by each miner to assure his life for 100l. But the figures show that more than a fifth of the deaths are violent deaths, or as they are usually called accidental deaths, so that 20 per cent. of the premium should be charged upon the employers in some way or other, which would leave only about 9d. per week to be paid by the miner. Whether the miners would agree to pay this I am not prepared to say, but if the premium was arranged as poundage upon their earnings, like club money in Cornwall, they would readily do so.

DURATION OF OUR COAL FIELDS.

SIR,—I read with much interest the report of the Coal Commission, published in the Supplement to last week's Mining Journal, but was much disappointed to find that in the five years the Commissioners have done absolutely nothing that they could not have done by the employment of a clerk of ordinary intelligence within a week of their appointment. They give us nothing but the very roughest estimates based upon previously published data, while as to the future I cannot see any ground whatever for the conclusions arrived at. The most that can be learnt from the report is that, even from present discoveries, we may look forward to 146,480,000,000 tons of coal at disposal, and that our present consumption is 110,000,000 tons. In looking into the future the reporters seem to have taken the most unfavourable period they could find whereon to make their estimate, and this is what I complain of. Why should the period since the introduction of free trade be chosen for making the calculation? The more correct method would be to take the date of the first use of coal, and find the number of years to the present time; then calculate the average annual rate of increase. This having been ascertained it should be calculated how long the 146,480,000,000 tons will last, assuming a corresponding increase.

Next we should try to get at the probable discoveries, but in a quite different manner to that which has been adopted. We should divide past time since the first coal discovery into 1000 equal periods,

and find the increase in the quantity discovered in each. The average found should be used to estimate the probable future discoveries, and we might find, though I do not say we should do so, that the discoveries are more rapid than the increase in the consumption, so that at the end of 360 years we may have, as we have at present, more than 1500 times of annual consumption still on hand as discovered reserves. Of course, if anything can be done to economise coal without interference with industry let it by all means be done—if a 10-horse engine can be worked with two-thirds the coal now used (theory tells us that it can be done with about one-eighth), anyone who can invent improved machinery for effecting that economy will be entitled to an ample reward in the shape of liberal royalties for his ingenuity, but if the report of the Coal Commission is to be taken as conclusive evidence that at the end of 360 we shall have no coal left, I am sure it would be most unadvisable to act upon it. D. F.

August 14.

DENUDATION OF THE COALBROOKDALE COAL FIELD.

SIR,—After reading Mr. Randall's explanations of the passages from his letter which I had quoted, I am quite willing to admit that I have been quite misled by them, and had gleaned by a perusal of them a different impression of their meaning from that intended by their author. I can only say that such misconception was entirely unintentional, and it is now quite beside the question to enquire whether those passages were fairly capable of the construction which I had put upon them, because the requirements of our science are satisfied by Mr. Randall's statement that his views have been always those of all other geologists upon the points raised. I shall be glad if the progress of mining operations in the neighbourhood of the Hem and Halesfield should prove that the older coal measures there were a headland, because it is my present impression that such was the case. If it were possible to show that the coals have there or elsewhere been preserved from the denudation by faults, it will have an important influence on the question of coal supply. I do not, however, anticipate that this will be so, though it is a point worthy of careful watching by Mr. Randall and other local geologists. My sincere desire is to eliminate scientific truths in all that I have written upon geological matters, and if I should happen to differ from my brethren in the science I do not wish to put forward my opinion dogmatically, but should always listen with attention to their views, and especially when, like Mr. Randall, they are my seniors in age and in the study of the subject. DANIEL JONES.

IRON SMELTING—THE FERRIE FURNACE.

SIR,—It would be a futile and endless task to prolong this controversy in the strain which "Smelter" tells us is his "own" peculiar "path." Throughout the discussion he has not advanced one argument, nor brought forward one fact to controvert the statements and data I have given. It is, from beginning to end, irrelevant rancour, through which no little petty jealousy may be seen; and when the discussion of any important question merges into an impotent tirade of abuse at those who venture to differ in opinion, the sooner such an opponent is ignored the better.

I challenge "Smelter" to prove that my data are erroneous. I challenge him to adduce evidence that in either England, Scotland, or Wales No. 1 pig can be made, *ceteris paribus*, with anything like the saving obtained by the Ferrie process. I challenge him, and deny that he can obtain, either by his "clay pipe," or other more practical modes, 65 per cent. of coke from ordinary Scotch coal; and I also challenge him to prove that mere height will give, *per se*, the results obtained by the Ferrie process. With his poetic description of Nature's gifts to Scotland, or the many other and varied "assumptions" he has seen fit to introduce into the controversy, as a practical ironmaster I have nothing whatever to do. They are foreign to the subject under discussion, of interest to none, save, probably, some amusement to himself. A NO. 1 IRONMASTER.

PURIFYING CAST-IRON.

SIR,—The use of Henderson's patent processes on a large scale, in the United States and in Europe, has established the following:—That cast-iron, containing 4 per cent. of silicon and 1·17 per cent. of phosphorus, when purified by two of these processes and puddled, produces fine-grained bar-iron, which, in the "muck" bar, is equal in appearance to best qualities of iron made from cold-blast pig-iron, and refined in the refinery, and puddled and heated, hammered and rolled, four or five times. The cost of producing this iron, including license fees, does not exceed 15s. per ton—the cost of making common bars from pig-iron by the old methods.

Cast-iron is purified by one of these processes at about 10s. per ton less than it can be done in the refinery; and the wrought-iron made from it, by puddling and once heating, and rolling the puddled bar, is of as good quality as the "best," made from the same cast-iron in the old ways. The average time of puddling the heats of the purified metal is 65 minutes, including white, forge, and foundry metal. There is no perceptible difference between the quality made from white or grey foundry purified metal.

Cast-iron is purified into steel by these processes, by partial decarburization, at not to exceed 30s. above the cost of pig-iron, and when good iron is used the steel will be pure iron and carbon.

Cast-iron, containing phosphorus in large quantities, has been purified into wrought-iron by these processes without the labour of puddling. The phosphorus has been eliminated from chemical combination with the iron as a phosphide; phosphoric acid remains in the slags mechanically mixed with the iron. The slags become separated from the iron when melted to form steel.

Ordinary hot-blast foundry pig-iron, when purified by one of these processes, contains less silicon than steel, and less silicates than cold-blast charcoal pig-iron, and the graphite carbon remains. In another of these processes the silicon and silicates are entirely removed, and the carbon is changed from graphite to combined carbon, and is taken from the iron in any required amount. Iron treated in these ways produces castings of greater strength and of higher finish than from pig-iron.

The processes, by producing iron of superior qualities at less cost and in larger quantities than by the old methods, will, no doubt, be appreciated by the producers of iron, and the inventor will receive liberal patronage therefor. JAMES HENDERSON.

LONDON JOINT-STOCK BANKING.

SIR,—What is joint-stock banking? Acceptances *versus* deposit, and current accounts. Why should the ratio per cent. of the former so materially and widely differ from the latter, when one bank is compared with another? The London and Westminster stands at the nominal figure of 4 per cent. only, the Union of London at 24½ per cent., whilst the City Bank ranges so high as 79½ per cent. Again, if the latter bank, with so many acceptances afloat, yields only 8 per cent. dividend on its comparatively small paid-up capital, allow me to ask what is the principle that justifies a premium of 24 per share, 10l. paid, on the market value? The deposit and current accounts amount to £2,366,266l., with acceptances of 1,878,090l. The London and County shares receive dividends of 20 per cent. per annum. The deposit and current accounts are 14,505,288l., and the shares sell at 33l. 15s. prem., 20l. called up. The City Bank shares are marketable at a price which yields the investor only ½ per cent. above that received by the proprietors of the London and County, whilst actually the price of the London and Westminster Bank shares, with its vast business, its almost entire freedom from acceptances, its large paid-up capital and reserve, pays the purchaser within ½ per cent. of that, with all its commitments to acceptances, the City Bank pays. The same argument applies to the Metropolitan. Surely the "Science of Investment" could a "tale unfold" in "bank and finance" companies as at present conducted.

A great deal has been advanced *pro* and *con*, in respect to past and possible future suspension of the "Bank Charter Act" at times of commercial and monetary pressure and difficulties, and also as regards at such moments the future policy of the Bank of England. Up to the year 1866 it has been stated that the growth of joint-stock banks was such as to compel the Bank of England to apply to Government for a suspension of the "Bank Act"; in fact, that at that and all future similar epochs the position—nay, the very existence—of the "Lady of Threadneedle-street" was and will be in the hands of those gigantic institutions who call "joint-stock banks," the magni-

tude of which outstrip the most visionary aspirations of the wildest theorists of a quarter of a century ago. It is a question alike grave and momentous, and worthy of the earnest consideration of the "directors," what the effects would be were the "Bank" to suspend specie payment; such, however, would have been the case in the last panic had the joint-stock banks withdrawn their large balances in "bullion" from the "Bank," as is generally believed they threatened to do, unless the latter applied without delay to the Government to suspend the "Bank Act." If this hypothesis be true that the "Bank" is at times in the hands of these mammoth companies, there appears to be only two courses to pursue—apply to the Government, or openly compete with the joint-stock banks for "money" on "deposit," and pay "interest" for the use of the same. In the first case, the "Bank" might be met by the refusal of the Government, and too late left to redress her own grievances through fostering too long the necessities of a greedy and exacting speculative public, but in adopting the latter course the reaction would prove immediate and effective; for at moments of danger and distrust no prudent capitalist would place with joint-stock banks money on deposit when equal and similar advantages were offered by the parent "house." The Bank of England has immunities and powers beyond all the joint-stock banks in London put together, and at this moment its resources extend to 35,839,670l., beyond the redemption of every outstanding commitment in existence, otherwise than those protected by "bullion" lying in the vaults.

Should such a catastrophe occur as the suspension of "specie" payment by the "Bank" for a single day, all the joint-stock banks would necessarily suspend payment at the same time, whilst the effects would paralyze their efforts to resume business, and, in many instances, extinguish their very existence; whilst the Bank of England would advance a "Phoenix" in its new strength, purified and rendered buoyant and healthy from its new-born freedom of those "trammels" and "suckers" that diverted its resources.

The London and Westminster Bank has a paid-up capital and rest of 3,000,000l.; deposit and current accounts, 22,786,263l., with acceptances outstanding of 919,517l.: total, 26,687,780l. For the half-year, June 30, the gains were 184,830l., equal to 12l. 6s. 4d. per cent. per annum on the "capital and rest," and 17l. 6s. 2d. per cent. on the gross amount at the disposal of the executive. The half-yearly dividend was at the rate of 18 per cent. annually on the 2,000,000l.; the "rest" of 1,000,000l., receiving no dividend whatever, so that we may fairly state this bank is paying 12 per cent. interest on the proprietors' money. The "rest" is the property of the proprietors, provided the 22,786,263l., and 919,517l. indebtedness to the public, is covered by the assets of the company, and their remains a surplus to pay it; yet it should be remembered that to secure this the capital of shareholders and the money of "depositors and customers" must remain intact. Some time ago the directors issued 50,000 shares of 100l. each, with 20l. paid, at 10l. premium, thus raising the "rest" to 1,000,000l. This movement, no doubt, strengthened the bank, and extended the power of the "board"; yet based on the present dividend, the shareholders refunded to the bank no less than 1·388 years interest, in order to bolster up the institution in public opinion. Had this movement not taken place the London and Westminster Bank would have paid 30 to 35 per cent. interest for the past year, and the shareholders be this 10l. per share premium in pocket. It would, in my judgment, promote confidence were the directors in their half-yearly statements to divide the sum of, in this instance, 22,786,263l. into "deposits," contra "current accounts." It is well known that the Bank of England allows no interest on money deposited, safety and immediate payment on demand being the only considerations they offer. The proprietors and the world could then judge the amount of "banking" business transacted, as well as the extent of the "borrowings," for such "money on deposit" unquestionably is!

The London and County Bank (1836) has a paid-up capital and rest of 1,500,000l.; deposit and current accounts, 14,505,288l. This bank has many branches, hence its acceptances are necessarily large—i.e., 2,640,138l. The dividend was the same as the London and Westminster Bank, but the capital and rest is only one moiety of the latter. The market value of these two powerful companies show that they do not stand on equal footing in public estimation. London and County shares are quoted 53l. 15s. each, and those of the London and Westminster 62l. 10s.; thus investors in the former will receive interest of 6l. 14s., and the latter 5l. 7s. 10d. per cent. annually.

It would be interesting to know the amount of business transacted during the half-year by an important bank like the London and County. We have weekly recorded the daily operations at the "Clearing House," and these returns are deemed of first moment by commercial men, and broadly advocated by the press. And this being so, how far more useful and pregnant with interest would be the returns of joint-stock banks. Shareholders would thus be informed of the business effected on their behalf by the officials of the bank, and also of the character of the business, if in the half-yearly statements the "deposit" and "current accounts" were separated. The shareholders are committed in their share liability to 30l., against 80l. in the London and Westminster, in addition to the paid-up capital. The latter bank is the more favourably regarded of the two, notwithstanding the increased subscription of 50l. per share. The interest on market value is just 1 per cent. in favour of the London and County. If, therefore, the two banks be of equal standing, their business conducted on equally sound principles, and the future be fraught with kindred promise, there is room for an advance in market value of 6l. 15s. per share on London and County.

The London Joint-Stock Bank paid-up capital and rest amount to 1,641,058l., against which the business conducted embrace money deposited, current accounts and acceptances, amounting to 14,616,633l.; the gains for the past half-year were 141,290l., and the dividend 20 per cent. per annum. The market value or shares stood at 40l. 10s. each, yielding to purchasers 7l. 2s. per cent. There is only a difference of 43,540l. in the gains of this bank and the London and Westminster for the period referred to, and the profits actually compare as 23·55 against 18·48 per cent. in favour of the former, yet the market value stood 62l. 10s., 20l. paid, London and Westminster, and 40l. 10s., 15l. paid, London and Joint-Stock, on the 30th ult. If the publication of the amount of acceptances, now withheld, in circulation would dissipate the distrust so apparent in the market estimation of this property the directors would act wisely to meet the requirements of the public. Why should the market value of the shares stand so low as to pay 7l. 2s., when the dividend is 20 per cent. on paid-up capital; while the London and Westminster only pays 5l. 7s. 10d. per cent., with a dividend of 18 per cent. only per annum?

The Union Bank of London declared a dividend at the rate of 20 per cent. for the year. The shares, 15l. called up, stood at 42l. each, at which they pay the investor 6½ per cent. annually; the position, therefore, of the original subscriber and the purchaser is as 20 and 6½ per cent. annual interest on capital embarked. The paid-up capital and rest of this bank is just 50 per cent. of that of the London and Westminster, yet the gains for the half-year stood at 121,281l., as against 184,830l. The dividend appears to be fairly won, and the balance in hand strengthened; the actual profits for the six months having been 20·21 per cent. annually on the paid-up capital.

It appears to me that the results of joint-stock banking cannot be correctly appreciated in the present form of half yearly returns—1. What amount of matured acceptances and loans due, yet not met, and paid, is wholly withheld.—2. There is no evidence whatever of the amount of money on deposit, and which must be regarded as "borrowed."—3. The amount of current accounts or banking transactions should be shown; this is essentially and practically the business recognised in monetary circles as "banking."—4. The business recorded in the books, distinguishing discounts from cash operations, should be given in the aggregate, and also monthly amounts, at each bi-yearly audit. We should then be enabled to judge somewhat for ourselves why the London and Westminster, with 26,687,780l. at command, gave only a dividend of 18 per cent. on 2,000,000l., and the London Joint-Stock 20 per cent. on 1,200,000l., with 16,257,631l. Again, the Metropolitan gave dividends of 5 per cent. on its capital, with only deposits of 589,992l. being under acceptance for 17½ per cent. of the amount. The Alliance Bank was under acceptance for 22½ per cent. of its gross deposits and balances on current accounts, yet declared a dividend at the rate of 6 per cent. per annum. In conclusion, the City Bank is under acceptance for 79½ of its deposits.

and current accounts receipts—2,366,266l.—yet the dividend was only 8 per cent. on its paid-up capital. The Bank of England notes in circulation amount to 25,724,230l., an increase over the previous weekly return of 689,960l. The bullion in the Bank is 26,213,138l., which, after providing for post-dated bills, 616,236l., leaves a deficiency of 127,328l. between the issue of notes and bills and the bullion in both departments of the Bank. The exceptional export of 1,000,000l. sterling to Germany is the cause of this reaction, and probably still further remittances will soon be made in the same quarter, for Prince Bismarck, in his settlement with M. Thiers, has evinced a decided preference for English bills and securities. It occurs to me that the Prince would do well to take of the latter payment in French Three per Cents. at their present reduced value. France would thus be relieved, and her securities advance in market value, whilst the European markets would soon relieve Germany of the stock. The wary Minister would thus make a profitable commercial operation, and in all likelihood with prudent judgment in the realisation still advance for the "Fatherland" the war indemnity, and by early evacuation of French territory permit that country to renovate her fallen position, if, unhappily, for years she does not regain her normal prosperity.

Referring to joint-stock banking business, we contend that the amount returned half-yearly, coupling the deposit and current accounts together, is no criterion; the former is borrowed money, and the latter the accumulated balances of legitimate banking—for comparison only, we beg to refer our readers to the returns of the following four banks named:—

	Deposit and current accounts.	Acceptances.	Div. on paid-up capital.	Div. on market value.
London & Westminster Bank	£22,786,263	£ 919,517	18 p. cent.	5.76 p. cent.
City Bank	2,366,266	1,878,090	8 p. cent.	6.25 p. cent.
Metropolitan Bank	589,992	102,191	5 p. cent.	6.25 p. cent.
London Joint-Stock Bank	14,616,633	Unknown	20 p. cent.	7.10 p. cent.

Why should the London Joint-Stock Bank shares stand so depreciated in the market as to pay the investor 7.10 per cent. interest, when the City and Metropolitan banks pay only 6.25?

Crown-court, Threadneedle-street.

R. TREDNICK,
Consulting Mining Engineer.

MINING MYSTERIES.

Sir,—For months past a fierce conflict has raged as to the merits or demerits of a certain dividend mine. At the last meeting, held in June, a balance was shown, so to speak, in favour of the mine of upwards of 1000l., and a dividend was paid out of this amounting to nearly 800l., leaving an apparent credit balance to carry forward. But as the costs were only charged up to April 22, whilst the tin sales were credited up to June 14, at least 3000l. in costs were unpaid; so that in fact there was really a debit balance of nearly 2500l. against the mine in place of a credit. But this is not all. A sale of tin of 11 tons 8 cwt. 1 q. 25 lbs. at 76l. 17s. 6d., amounting to 875l. 10s., appears by the balance sheet to have been made just in time for the meeting, though, strange to say, this particular sale has never made its appearance in the *Mining Journal*, though all other of the mine's tin sales have invariably been recorded there. Uncharitable parties have in consequence, and with apparent reason, intimated that this sale was an impromptu one, to afford a decent pretext for a dividend at the rate of 3½ per cent. upon a market value of 10l. per share, and as up to the end of July only two tin sales have been recorded since the meeting, there is reason to think that the supposed fictitious sale had to be made up, and the borrowed credit repaid. Supposing, now, the returns of tin to be for August 30 tons, and for September and October 10 tons for each month, the mine can (even reckoning the tin to sell at 80l. per ton) only expect to have a credit balance of 2000l. at Oct. 22, less the cost of new dressing-floors and stamps, so that at most a dividend of 5s. per share, or 7½ per cent. upon a market value of 10l. per share, can then be consistently declared. It is true, by leaving two months' costs in arrear, according to a most reprehensible practice, a dividend of 10s. per share may then be declared; but this kind of proceeding is very much like paying a dividend out of capital. The shares in this concern are now, I believe, as high as 10l. each, due, it is said, to market operations, but more I think due to the want of cool reflection on the part of those who are, in consequence, made the victims of market operations.

August 14.

* It was duly inserted in the *Mining Journal* of June 17.

MINING IN CARDIGANSHIRE.

Sir,—For the last fortnight I have been so much engaged with gentlemen visitors in going through a number of mines in this county that I am still obliged to postpone my reports upon the mines lying between Goginan and Machynlleth until next week; at the same time I am proud to congratulate the shareholders of some of the mines that we have gone through upon their improving appearance, and hope they may continue to improve until they equal or surpass the United, West, Esgrail, Llan, Bronfard, and other good mines in Wales—and those new mines, as yet not brought to market, that will astonish even the greatest Welsh mining superlative by-and-by.

Rheidol Cottage, near Aberystwyth, Aug. 15.

S. TREVELYAN, M.C.E.

CEFN CONSOLS MINING COMPANY.

Sir,—I wish to ask, through the medium of your influential *Journal*, a few questions respecting Cefn Consols. I find, on referring to the *Mining Journal* of March 19, 1870, that the shares were quoted, "business done," at 5½ to 6 per share; since then some lead ore has been sold, and I presume the mine is now in a better state than it was a year ago—at least, so I am informed by the officials of the company. If it be true that the mine is a *bona fide* one, and was "brought out" for the purpose of really working it fairly, and not as a "market mine," how is it that the shares are not saleable on the Stock Exchange, nor in any other way? It was said that before this time the shares would be at 50l. each. I fear that fifty shillings must have been meant. In your *Journal* of August 12 I see that Mr. H. Mansell advertises 40 Cefn Consols for sale, but puts no price. If Dr. Collis Browne, the Chairman of Cefn Consols, knows that these are for sale, surely he will at once buy them, if he has any faith in the adventure? I must confess that I should like to hear of something being done at the mine, and, as one of the original shareholders in it, and a considerable holder of shares, I think we must organise a "Committee of Investigation."

Aug. 14.

A SHAREHOLDER.

CHIVERTON MOOR MINE, AND ITS MANAGEMENT.

Sir,—I am pleased to see that "A Shareholder" has called attention to the management of Chiverton Moor Mine, and I am more particularly pleased because I believe that a very valuable property, and one that without doubt could, under proper management, be made highly productive, may, as many other similar concerns, be made a source of annoyance to those who have any interest in it, and an injury to mining speculation. Your correspondent states that with London management, if the secretaries and committee do their duty, we have some guarantee that our money is properly expended. All I can say in answer is, that the secretaries were the secretaries to North Roak Mine, and that owing to the very unsatisfactory state of the management it was transferred to Cornwall, and the result has been that confidence has been given, and the shares in a very few weeks rose from 9l. to 25l., and at the present time stand at 20l.

A CONSTANT READER.

THE QUEEN, AND VIRTUOUS LADY MINES.

Sir,—As a shareholder in the Virtuous Lady and the Queen, I should like to ask Mr. T. J. Barnard, the secretary, the cause and the meaning of the sudden and great fluctuations in the price of the shares of these two mines, which fluctuations seem entirely dependent on his will and pleasure. A little while since he was advertising Virtuous Ladies at 30s., now more recently at 17s. 6d. Again, some time ago he advertised Queens at 2l. 10s., now he solicits the purchase of the public at 25s. I surely any shareholder is justified in publicly asking what are the cause and meaning of these changes, which give such an air of instability to his property, especially when, in the case of the latter mine, Mr. Barnard only last week described it as a new El Dorado or a second Brierley.

Another question I should like to ask:—If the 1000l. fresh capital is sufficient for the amalgamation works, why was five times that sum attempted to be raised by the issue of 5000 new shares? and if the directors considered the 5000l. necessary, why, the mine being so rich in silver, as asserted, is the sum spread over, under the circumstances, extraordinary period of two years?

Finally, are the shareholders allowed to receive dividends during the two years? If so, from what source; and, again, if so, why call up more capital? I hope, Mr. Editor, the secretary will see fit, with your permission, to give a reply in the *Journal* to questions so interesting to the body of shareholders.

INVESTOR.

THE UTAH SILVER MINES, U.S.

Sir,—I should be much obliged to any connected with this property if they would authoritatively inform me if the Utah Silver Mine is a true fissure vein, or if there appears a difference of opinion among the brokers; in fact, some assert that it is a true fissure vein, and others that it is not so. If you would allow this question to appear in the *Journal* it would oblige many besides the writer, who wishes to be an honest broker, and lay facts before his clients. That there is a doubt on the subject is clear, the shares in the company having receded from 14l. to less than a month. In the *Mining Journal*, July 1, it was stated that there was positive proof of its being a true fissure vein, but there has been no corroborative evidence of the fact, James Nancarrow merely reporting on the subject in these words, "These appear to be two great runs of metal-bearing veins." Possibly some gentleman now in England, and who knows the mine, would oblige us with the true information.

MINING BROKER.

[For remainder of Original Correspondence see to-day's *Journal*.]

CONDENSING STREAM.—Mr. M. BURNETT, Spennymore, proposed to pass the whole or part of the water raised by a pump through a metallic casing surrounding the whole or part of chimney for the smoke or products of combustion from a furnace, such products of combustion, after having been cooled by means of the casing coming in contact with a stream or streams of water, and being further cooled thereby. The exhaust steam from a non-condensing engine or engines is allowed to escape into and be condensed along with the condensed steam and products of combustion. The resulting combined

stream or streams is or are then allowed to escape freely by gravity, or can, if required, be got rid of by pumping. The apparatus may be varied in order to suit the various constructions of furnaces and boilers, and the situation of the same to which it may be applied.

CORNWALL AND DEVON MINERS' ASSOCIATION.

The annual meeting of the Miners' Association of Cornwall and Devon was held on Monday in the Polytechnic Hall, Falmouth, Mr. A. P. VIVIAN, M.P., presiding. There were also present—Rev. S. Rogers, Messrs. F. Hill, F.G.S., C. Fox, R. Blee, R. W. Fox, F.R.S., R. R. Broad, A. Fox, James Williams, William Tyack, B. Kitto, T. Quentrell, A. K. Barnett, F. Dingley, jun., Capt. Noble, Capt. Bryant, and Capt. James. A letter was read from Mr. Hunt, F.R.S., the hon. secretary, excusing his non-attendance.

The Council reported, through the Rev. S. Rogers, that the work of the Association had been carried on much as usual during the past year. Though the number of passes in the South Kensington examination had been slightly less than those of last year (80 instead of 84), they pointed with pleasure to the fact of the increased proportion of higher classes (7 first and 13 second of the advanced grade), as evidencing the efficiency of the work. After a careful comparison between the results of the last two examinations the committee had selected the following to receive the prizes placed at their disposal by the editor of the *Mining Journal*: Chemistry—E. G. Dyke, St. Austell, 2nd, advanced; mineralogy—John White, Pendennis, 2nd, advanced (he also gained the following honours this year)—Chemistry, 2nd, advanced; geology, 2nd, elementary; mining, 2nd, elementary; geology—T. Quentrell, Helston, 1st, advanced (also 1st, advanced, chemistry); mining—Hugh Stephens, St. Breage, 2nd, advanced (also chemistry, 2nd, elementary; mineralogy, 1st, advanced). The Council had decided on giving this year a small prize, in the form of a book, to each one who passed in the examinations, and who was not entitled to a prize from the Department of Science and Art. It was very desirable that competition should be encouraged among the members of the classes in such trials as might test the practical results of the instruction they had received; and with this object in view the Council ventured to suggest, in a former report, that prizes should be offered for raising minerals, or rocks, or fossils; for a simple chemical analysis; for a mechanical drawing, and the like. They hoped to re-consider the whole question next spring. It should be borne in mind that the results of the examinations did not accurately represent the full amount of the work done by the Association, inasmuch as mine captains, mine clerks, and others often attended the classes without any intention of presenting themselves for examination. Others, again, not unfrequently obtained appointments which removed them from the vicinity of the class shortly before the examination was held. Others emigrated before the course was finished, and many others from various causes attended a portion only of the lectures. Much useful technical instruction was thus diffused which was not indicated by the list of passes. Arrangements would, probably, be made for carrying on classes or sub-classes at the centres already occupied, and also at St. Austell and Redruth, the details of which would shortly be announced. The Council were glad to be able to report a slight decrease in the amount of excess of liabilities over credits in last year's balance-sheet, as compared with that of the previous year. They also had the pleasure of announcing a donation of 25l. from the Duke of Cornwall, and 10l. from the Warden of the Stannaries, and 10l. from the Earl of Mount Edgum.

Mr. COLLINS, as lecturer, reported that the various classes had been very successful in their studies during the past year. The examinations were conducted as usual by the Department of Science and Art in the month of May. The number of passes was somewhat less than that of last year, but there was a larger proportion of first classes in the advanced grade—always a difficult position to attain. Last year they had but two of these; this year there were no fewer than seven. The classes had suffered this year from the loss of two of the district teachers during the season of study, Captain Henty, who was teaching the principles of mining in Breage, having left in November for Spain, and Mr. J. J. Eddy, who was teaching mineralogy, having left in April, a few weeks before the examinations. At Helston the mineralogical examination fell through from the local inconvenience of the night fixed for it by the Department of Science and Art, none of the pupils being able to attend. The competitions for the vanning prizes offered by Dr. Foster and the Council of the Association were kindly conducted as before by the mine agents appointed by that gentleman. At Breage the 1st prize of 1l. 1s. was awarded to Thomas Quentrell, of the Helston class; the 2d, 5s., to William Henry Argall, of the Breage class. The trial was under the superintendence of Capt. S. H. Harris, of Great Witley, and the 1st prize was awarded to Francis Jenkins; the 2d, 5s., to John Eddy.

The PRESIDENT expressed regret at his absence from the last annual meeting, which resulted from unforeseen circumstances. He felt assured that the Association did not suffer from his absence, in consequence of Mr. St. Aubyn, M.P., being there to fill his place. Although there was much in the report on which they might congratulate themselves, the financial position of the Association was not such as they could desire. Yet even this was improving, the debit balance at the end of last year being 10l. less than that of the year before. This year there had been several large donations received, and he, at the suggestion of Mr. Hunt, had brought the Association under the notice of the Duke of Cornwall and the Lord Warden of the Stannaries. Although the number of passes this year was less than that of his predecessor, yet from the quality of those of this year the Association ought to feel that they had advanced in this also. In the Blue Book issued by Government, containing reports from inspectors of scientific schools, Capt. Donnelly referred to the great difficulty there was in finding good local teachers, and under these circumstances they ought to be very proud of possessing the services of Mr. Collins as lecturer and secretary. The only student who obtained the Queen's medal for mineralogy throughout the whole kingdom for the last year was John Provis, of Camborne, who was a pupil of Mr. Collins. It had always been a matter of wonder to him why the Association had not been more supported by employers and others who took an interest in the industries of that county. He feared there existed some idea that this elementary education in science might in some way interfere with the practical work of the labourer. There could not be a greater mistake. (Hear, hear.) Speaking as an employer of labour himself, he would certainly much sooner have under him a man who, when he saw the column of black smoke coming out of his boiler-stack, would be able to reason scientifically, and say "This is igniting but uncombusted fuel, and by some means or other I must manage to ignite the fuel and convey it to the atmosphere, and have the oxygen which is necessary to produce combustion, and by those means have more steam." The man could suggest to his employer the means by which this could be carried out. He (the Chairman) had seen that done, and he had seen a large mill-engine driven by three instead of four boilers, thus saving 25 per cent. of fuel. In England they had an unlimited supply of fuel, but as they got deeper into the earth, and had to abstract it from a greater depth, it would become more expensive; and in order to compete with the world they must economise their fuel, even now, to the greatest extent. (Hear, hear.)—and having men of the class he had mentioned to work for them, he would certainly be the best means to do this. Railway companies—he knew the Great Western did—offered rewards to the engine-drivers who were able to drive an engine with the smallest quantity of fuel over a given distance, and by this means most considerably reduced the consumption of their fuel. The sort of knowledge given by that Association was well calculated to be of immense service to what he might term, using an army phrase, the non-commissioned officers of the employed—that was to say, not so much to the rank and file, as applied to the common miner, but to those who were in some degree a little over the rest; but it must be borne in mind that the non-commissioned officers of the army who occupy similar places in the non-commissioned officers also must make themselves competent in the rudimentary scientific knowledge, and he must say for himself that if he had to raise a man to take a sort of superior position it would go a great deal in his favour, if he had the machinery under his charge, if he possessed a rudimentary scientific knowledge. His own opinion upon the value of that knowledge was, perhaps, better borne out by the fact that last year a situation became vacant under him, and the first thing he did was to try to fill it up from among the pupils of Mr. Collins. It had always been a matter of great satisfaction in saying that he had been recommended by Mr. Collins, coming from the neighbourhood of Chacewater, and who had now been with him three or four months, he did not think would give him any cause to regret the step he had taken.

The report of the Government inspectors, showing what was doing throughout the kingdom with regard to scientific education, stated that in 1865 there were 120 schools, and 5479 pupils undergoing instruction in them; in 1866, 153 schools, 6335 scholars; in 1867, 212 schools, 10,230 scholars; in 1868, 300 schools, 15,000 scholars; in 1869, 323 schools, 24,865 scholars; in 1870, 399 schools, 34,283 scholars. In 1868, 769 pupils were examined, and 5290 prizes obtained; in 1869, 13,234 pupils were examined, and 1969 prizes given; in 1870, 16,616 were examined, and 3108 prizes obtained. After 1868 the examinations became so materially harder that whereas in 1868, 5246 passed out of 7000 examined; in 1870, 3000 only passed out of 16,000 examined. The increased severity in the examination had been reported to be judicious, but Capt. Donnelly had now said that any harder examination would be injudicious. And now that they had reached the climax of severity, and the pupils knew what was expected of them, they would not be at a standstill, but would work so as to make the prize-takers be equally as high as in the first instance. In a county such as Cornwall the desirability of supporting an association of that sort could not be too strongly spoken of. He was entirely averse to interfering with the practical education of the working man—(applause)—and he would not urge anything which he thought to do so; but he was decidedly of opinion that a boy, in order to become a good working man, should not certainly learn his practical trade later than fourteen years of age. Before a boy was fit to go underground and take the position of a man there was plenty of time for him to get a grounding of elementary scientific knowledge; and only that, after he had begun to work, if he had got a taste for it, there were always such things as evening classes and night schools. He had had as many as 64 working men attending a night school which he encouraged. In the generation which was now passing by very few among the working men in that town could speak English, or read or write, but in the generation which was now rising there was hardly a man who could not speak English as well as Welsh, and in that way they were able to diffuse knowledge more, and fit themselves to take higher positions than it would be otherwise possible to do. He had seen it himself in the army this year in the cases of men in the ranks whom no one could find fault with for behaviour or proficiency in drill, and yet who could not be raised to the position of non-commissioned officers because they could not read or write. He saw more and more every day how desirable it was to promote the education of all sorts throughout the country, and it was highly desirable that the people of Cornwall should come forward and more liberally support the Miners' Association, in order that the ugly balance on the wrong side might be removed, and endeavour to extend its useful sphere of diffusing knowledge throughout the country, and being able to purchase a good suitable lending library, which would be of the greatest value to every class connected with the mines and other industries throughout the county. (Applause.)

A paper was then read on "The Comparative health and longevity of Cornish Miners," by Mr. Robert Blee. In the year 1847 the Royal

Cornwall Polytechnic Society published in its fifteenth report a paper on the health and longevity of the mining and other populations of the Redruth Union. The tables accompanying that paper bore evidence of the great extent to which the health of the mining population had been affected during a period then not long preceding by the labours in which they had been engaged. In the quarter of a century which had nearly expired since that paper was written much good had been done by the safety, and by isolated companies of adventurers, in the hope of lessening the danger of the miners' occupation, and it might be of advantage to enquire into the effect all those arrangements might have had on the condition of the people for whose benefit they had been made. Mr. Blee had directed enquiry mainly to three points, as in the paper read in 1847—the proportions in which miners died at different ages, the diseases of which they died, and the comparative number of fatal accidents which had occurred among them, taking the four principal mining parishes in the Union—Redruth, Illogan, Camborne, and Gwennap—for a period of ten years, from January, 1860. On the whole, the children of miners did not show a rate of mortality very different from those of other classes. In Redruth and Illogan the infant children of miners died in somewhat larger proportions, while in Camborne and Gwennap the difference was in favour of the miner. (Applause.) Miners of feeble frame or peculiar susceptibility to disease very early succumb to the fatal influence of their occupation. Twenty-eight per cent. of the miners registered had died between the ages of 10 and 30 years, and of non-miners only 18 per cent. had died between those ages. Between the ages of 30 and 50 years the difference was largely increased, miners dying at that period in the proportion of 36 per cent. while for other males the proportion was only 20 per cent. Miners living to the age of 70 were 9.07 per cent.; men of other occupations, 31.06 per cent. In the two periods, 1847 and 1871, it was shown that whilst up to 50 years of age fewer miners now died than did 25 years ago, now many more died at more advanced ages. He concluded that much of the improvement in the working classes was due to the increase of wages, and the lessened price of bread and other necessities of life. Miners died in immensely larger proportions from disease of the chest than other classes—49 per cent. against 27 per cent.; and the protection from this cause of death, most imperatively required, seemed to be efficient ventilation, improved modes of ascent from the depths of the mine, and careful protection from the great and sudden changes of temperature. It was shown that out of those accidentally killed 70 per cent. were under 29 years of age, and half of these were youths 13 to 19 years old. It was a question whether miners were sufficiently remunerated for the perpetual risk of life and limb they encountered; but that could only be satisfactorily determined by more minute investigation than was generally given it. The manner in which miners were paid was chargeable with much of the disadvantage to health, and it was a most excellent man, and a man who had left behind him a useful name, that he should have been so long in the position of a public-house to change the money, and thus were tempted to spend it. While thanking the Royal Cornwall Polytechnic Society for what they had done for the advantage of the working miner, he begged them not to think that they had already done all that might be done for his benefit, and asked them to continue their exertions on his behalf.

Mr. HILL said the adventurers were always desirous of doing full justice to the miners, and if this was alleged to be not so, perhaps they would get some of those scenes which had disgraced the North of England. He spoke very highly of the conduct of the Cornish miners now as compared with years ago.

Mr. C. FOX said the last return showed that there was a death every other day from the mode in which the men were raised from the pits.

Capt. JAMES, as a miner, spoke highly of the miners' position now, and denied that they were dissatisfied.

The PRESIDENT praised the conduct of the Cornish miner. They should be careful to invite in no way the Legislature to interfere in what was unnecessary, and in what was not absolutely required, at the expense of the adventurers.

The Chairman was thanked for presiding.—*Western Morning News*.

ROYAL CORNWALL POLYTECHNIC SOCIETY.

The opening day of this year's exhibition was not so well patronised as has been the case in former years. Everything had been perfectly arranged, and the new offices attached to the building were brought into use. The President of the society, Mr. CHARLES FOX, addressed those present in advocacy of the institution, forcibly pointing out that its primary object was to promote and encourage an industry for the investigation of scientific pursuits, to create and encourage a growing taste and appreciation of the fine arts. Such an institution must eminently commend itself to their sympathy and practical support. Science was ripe to overflowing with subjects exciting the liveliest interest, and he could speak freely of the advantages which such application offered, and of the good results applied study gave birth to. This society did not aim at forming a museum, which was the special province of the sister society, the Royal Cornwall Institution; but it aimed at creating a public taste for pictorial representation, which was beyond the province of their greater sister society. That such a society should do some good, however limited, was a fair argument that such institutions were more or less valuable, and he was glad to say that the Royal Polytechnic was not without success. But, while they still had a large number of good supporters, they had lost by the death of Sir T. D. Acland, who was one of their members, and one of their best friends in the West of England. Sir Thomas was one of those who loved the profession of the pen and the brush, and they must always remember him as a most excellent man, and a man who had left behind him an unsullied name. The speaker especially impressed upon the meeting the importance of training the young in the study of scientific subjects, to learn them to observe, and with flexible fingers to put on canvas creations of the mind. No county offered more special features than Cornwall for scientific study. Cornish cliffs were noted for their romance and beauty; indeed, the whole county was at once a marvellous attraction for the antiquarian and the inquisitive. It abounded in all those qualities which the scientific man delighted to roam in, and he hoped there would be no very marked lack of appreciation of those distinctive local specialities which formed in their interesting country.

The various judges had in some cases prepared very elaborate reports of the respective departments. The naval architecture was said to have vastly improved over that of former years, shown by some splendid models of steamships, and of a battery now being built at Newcastles. Models of steamships were exhibited intended for the India and China trade, via the Suez Canal, which had immense advantages for cargo and passengers and a light draught of water, in comparison with ships hitherto built. The judges had very much pleasure in awarding the first silver medal of the society for these splendid models of naval architecture. There was also exhibited the model of a merchant steamship adapted for general trade, with extensive carrying capabilities, good speed, and small consumption of fuel. There were also exhibited some good models of local workmanship.

In the Statistics, Essays, &c., Department, the prizes were:—On the Comparative Health and Longevity of Cornish Miners, by Robert Blee, first silver medal; On the Mineral Phenomena of Huel Rose, in the parish of Stithney, by Hugh Stephens, prize 5s.; On Mineral Phenomena; Velins at Constantine, by George Noble, prize 7s. 6d.

In the Mechanical Department, the prizes were:—Polar detector, David McCallum, highly commended; compass register, ditto, first silver medal; bookbinding saw, for facilitating and regulating the sawing of the backs of books, J. Turner, first bronze medal; model of Stephens's patent pulveriser, S. Stephens, first bronze medal; model of Stephens's towing machine, highly commended; machine for cutting sections of rocks and minerals for microscopic purposes, invented by James B. Jordan, jun., first bronze medal; card printing machine, with accessories, Eugene Menel, highly commended; improved cooking apparatus, Samuel Terrill, Redruth, first bronze medal; improved lock, J. W. Curtis, prize, 10s. 6d.; decorated tin plates, P. W. Flower, first bronze medal; plan of Great South Chiverton Mine, Capt. N. Bryant, prize, 10s. 6d.; plan of Keallioke Mine, County Cork, E. T. Courtes, prize, 1l. 16s.; section of the north of Cape Horn, showing the Wharfedale and other rivers, with specimens of the rocks, Capt. John Maynard, first bronze medal; map of some elvan courses in the neighbourhood of Truro, with descriptions and specimens of rocks, A. K. Barnett, second silver medal; patent self-indicating hydrostatic weighing machine, weight 60 lbs., capacity, 3 tons; ditto, weight 100 lbs., capacity, 10 tons; ditto, weight 15 lbs., capacity, 25 cwt., F. E. Duckham, first silver medal; improved miners' theodolite, by E. T. Newton, F. T. Newton's telescopic dial legs, for dialling in cramped places, lengthened or contracted to suit the convenience of the surveyor, prize, 1l. 11s. 6d.; Firmin's patent "Toll-Tale," or self-registering liquid gauge; model of the fireman's warning or automatic steam-whistle, "Toll-Tale," Liquid Gauge Company, commended; the oscillometer, for determining the amount of oscillation in vessels at sea; ditto, William Hubbard, first silver medal; skeleton model for teaching crystallography, invented by William Tyack, and contributed by Mr. J. Wood, first bronze medal, and 10s. for workmanship; inlaid workbook, Alfred Barbary, prize, 10s.; cabinet for microscopic objects, exhibited by permission of Mr. J. H. Collins, T. H. Fletcher, prize, 1l. 1s.; fracturing, &c., carried out of peach stones, Charles H. Bennett, prize, 7s. 6d.; drawing of man-engine at Great Huel Velins Mines, Richard H. Trenggony, prize, 5s.; blowpipe, with sloping jet, centre light, Bunsen's burner, and stand, Thomas Fletcher; blowpipe, with upright jet, ditto; furnace for fusions below a white heat, ditto, first bronze medal.

DR. BARHAM ON THE HEALTH OF CORNISH MINERS.—At the annual meeting of the British Medical Association, at Plymouth, Dr. Barham said he thought the most interesting form an address could assume would be an enquiry into some topic of medical interest peculiarly local. He had selected that of the health of Cornish miners, which he should treat in connection with that of the miners of Durham, Northumberland, and Staffordshire. The two royal commissions that had been issued had resulted in several reports and a volume of statistics on the subject. He should not enter into them, but should examine into the comparative longevity of the miners in the different counties. The most conspicuous form of disease prevalent among miners could be traced to the ill effects of mining on youth, and resulting in the terrible sacrifice of life, and was consumption. The deaths from ordinary causes between the ages of 35 and 40 among the miners of Cornwall were not more than those of Northumberland, Durham, or Staffordshire; but the deaths from consumption in Cornwall were immensely in excess of the other districts. The rate of deaths from heart disease in Cornwall did not equal that of Northumberland; while for accidents no other district was at all to be compared with Staffordshire, where seven out of 10,000 died from those violent explosions that create such alarm every now and then. With regard to the causes of consumption in miners, it was to be attributed to the want of light and air, to exposure, and to liability to inflammatory affections, the result of too early employment. Some of the mining children work as early as 13.

ELECTRIC INDICATORS.—By the invention of Mr. E. J. C. WELCH, of Hampstead-road, Middlesex, the indicator consists of a number of plates, on which are written the words which it is desired should be shown. Reels of the suited wire are fixed in a metal frame, with a horse-shoe magnet. In front of the horse-shoe is a hinged iron shutter, having a notch on the side. When

The indicators are in their normal position the levers rest in a notch, but upon the current being passed the shutter is drawn towards the magnet, thus allowing the plates to fall, and expose a hole in the face of the case. Instead of the current being broken each time the hammer strikes the bell, as heretofore, the coils of the bell magnets are simply cut out of the circuit as the hammer is attracted and strikes the bell.

OUR GUN-COTTON.

We use the possessive pronoun in order to draw a marked distinction between the article lately adopted in our military service and the crude, treacherous, and comparatively expensive substance, invented in 1846 by Schönbein, and subsequently introduced with improvements into the Austrian service at the recommendation of Baron von Lenk. "Give a dog a bad name, and hang him," is an adage peculiarly applicable to gun-cotton. The first attempts to practically utilise the philosophical researches of Professors Schönbein and Böttcher were attended with such disastrous consequences in this and other countries that gun-cotton was ultimately condemned as a thoroughly treacherous and highly dangerous compound, fit only for the chemist's laboratory or the specimen bottle of the lecturer.

It is unnecessary for us to recapitulate here the chapter of accidents which preceded the abandonment of all further manufacture of gun-cotton in this country. We have already in a former article noticed several of these and incidents of history, and our readers may gain further information by referring to an able paper on the subject by Lieut.-Col. F. Miller, V.C., R.A., published at p. 65 of the fourth volume of the "Proceedings of the Royal Artillery Institution (1865)."

We may say that in 1847-48 gun-cotton was given up and condemned in all countries but one. Austria still clung to the idea of the German chemists, and to Austria belongs the credit of pushing forward all practical inquiry with respect to gun-cotton up to 1862, when the subject was revived in this country by the Royal Society.

The subsequent history may be briefly told. A special committee was appointed to examine into the applicability of gun-cotton to military purposes, and to mining and other engineering operations. After a series of promising experiments this committee was rather suddenly dissolved. It was rumoured at the time that its elements, being antagonistic, would not bind, and the prosecution of the inquiry was handed over to the Ordnance Select and Royal Engineer Committees. Meanwhile, Mr. Abel, the Chemist of the War Department, had been actively engaged in investigating the properties of gun-cotton when prepared under varying conditions, and it is to him we owe the perfection of the present manufacture. Mr. Abel's preliminary researches were embodied in two elaborate contributions, published in 1866-67 in the "Transactions of the Royal Society," to which a third, on the history of explosive agents, was added in 1869.

The main results arrived at by the special committee previous to its dissolution may be stated as follows:—First, it was proved that gun-cotton, as made by the Austrian or Von Lenk process, is, with proper precautions, decidedly superior to gunpowder in blasting operations, but is inferior to it as a propelling agent in either small arms or artillery, both on the score of danger to the gun and loss of accuracy in the shooting. Secondly, it was shown that the full explosive power of the Von Lenk material could not be developed in either land or submarine mining without confining the cotton in a strong vessel previous to its ignition. In the Austrian process the cotton is made into skeins, which, after the usual treatment with acid, &c., are made up into convenient forms. Artillery cartridges have been made by winding the cotton round a hollow cone of wood and for the bursting of shells, and for use in small arms, the cotton has been woven into a continuous hollow cylinder; for mining purposes it has been twisted into a hollow rope. It is apparent that the fibre of the cotton is more or less long and loose in all these forms, and herein lies the principal defect of the Austrian method.

The most searching purification cannot altogether get rid of impurities, and finished gun-cotton is thus liable to change and to decomposition. Spontaneous explosions follow, and a coroner's jury brings in a verdict that "no evidence appeared that the explosion arose." The loose and porous condition of inferior cotton likewise tends to very rapid inflammation. If a loose mass of gun-cotton wool be inflamed in the open air by ordinary contact with heat, it will flash into flame with a dull explosion. If the same cotton be in the form of a woven fabric, the rapidity of the inflammation will not be so instantaneous; but if the escape of the gases from burning gun-cotton rope or yarn be retarded by enclosing the material in a wooden box it will explode violently if ignited by the ordinary application of heat. A store of this gun-cotton would thus, if accidentally fired, explode with possibly disastrous consequences. The principal object of Mr. Abel's investigation was to ascertain the defect in the Austrian process, and we shall presently show how promising have been his labours in this direction. In 1865 Mr. Abel devised a new method of manufacturing gun-cotton; this consisted in reducing the gun-cotton to the form of very fine pulp, and subsequently pressing this pulp into solid cakes, or converting it into grains or pellets, and this is the process followed at Messrs. Prentice's works at Stowmarket, and about to be adopted in the Government factory now in course of erection at Waltham Abbey. The advantages gained by the Abel process, in comparison with that of Von Lenk, are very marked. With the latter a long-staple expensive cotton must be employed, while ordinary cotton waste can be used in the Abel process. The operations incident to the Von Lenk process extended over a period of four weeks; Abel's gun-cotton can be manufactured in four days.

We have already referred to the practical impossibility of thorough purification by the Austrian method. During Abel's process the fibre is reduced to such minute particles that the retention of impurities is reduced to a minimum, and the finished gun-cotton should thus be perfectly stable even in tropical climates. The conversion of Austrian gun-cotton into woven fabrics or twisted rope is more or less dangerous, owing to the necessity of working with dry material. With the Abel process absolute safety is secured during the whole manufacture, as the material is in the wet state throughout, and could thus be stored damp, if so required. This necessity, however, did not appear to exist, as experiments had shown that the compressed gun-cotton if inflamed, even when packed in wooden cases, does not explode; it merely burns rapidly. This was looked upon as one of the most marked features in the differences which exist between the two processes. A store of Austrian gun-cotton, if accidentally ignited, would explode with violence, whereas under similar circumstances a storehouse of Abel's composition, judging from the result of experiment, would merely burn like any other building.

Lastly, in order to develop the full force of the Austrian cotton as an explosive agent, it is necessary to confine it either in strong vessels or by secure tamping. The compressed gun-cotton may, on the other hand, be made to exert its full destructive force without any confinement whatever. When employed in the demolition of buildings, it is only necessary to lay it in a heap on the basement floor; when used in torpedoes the surrounding case need only be of a strength sufficient to resist the pressure of the water at whatever depth the torpedo lies. This is an immense advantage, and is due to a remarkable property possessed by gun-cotton pulp in the compressed state.

Experiments have shown that Abel's gun-cotton, when placed in the open air or packed in ordinary wooden cases, can only be exploded in one way—by detonation; that is to say, by a fuse containing a certain quantity of fulminate. When ignited in this manner the compressed cotton detonates violently, completely shattering the substances in which it is in contact. Austrian gun-cotton will not detonate. If a tube or fuse of mercuric fulminate be buried in gun-cotton, which is the form of wool or spun yarn, its explosion does not develop the same violent action as if the cotton were in the form of a compact homogeneous mass such as it presents in the compressed state. Gun-cotton rope does not even detonate when placed in contact with a compressed charge of gun-cotton which does detonate.

The difference in the behaviour of such explosive substances as nitro-glycerine and its compounds and gun-cotton when exposed to the influence of a source of heat has been made the subject of careful investigation by many distinguished chemists in this and other countries. M. Nobel has shown that crude nitro-glycerine can be rendered perfectly safe by contact with a small charge of confined gunpowder or by a large percussion cap.

It occurred to Mr. E. O. Brown, Assistant Chemist of the War Department, that gun-cotton might also be ignited and exploded by detonation. Experiment proved this to be the case when the particles of the cotton were in a finely divided state, and when its mass had been subjected to powerful pressure. Further trials, however, showed that gun-cotton is not nearly so sensitive or so susceptible to detonation as nitro-glycerine. The detonation of compressed gun-cotton cannot be accomplished by the explosion of ordinary fulminates. Nitro-glycerine can even be detonated in contact with compressed gun-cotton without exploding the latter. An electric fuse charged with 100 grains of a mixture of sulphide of antimony and chlorate of potash has been fired on a disc of compressed gun-cotton without causing any explosion. The gun-cotton merely ignited and burnt away. A bottle containing three-quarters of an ounce of pure nitro-glycerine has been detonated on the top of a disc of compressed gun-cotton without exploding the latter. The gun-cotton in this case was scattered by the violence of the explosion, and fragments of it inflamed. A detonating fuse containing 10 grains of mercuric fulminate failed to explode a hank of gun-cotton thread, while half that amount of fulminate was sufficient to cause compressed gun-cotton to detonate violently. These experiments support the views held by Mr. Abel:—

1.—That gun-cotton, freely exposed, cannot be detonated by any explosive agent less sudden and violent in its action than mercuric fulminate.
2.—That nitro-glycerine, which is more readily exploded by a blow than gun-cotton, may be detonated through the agency of explosive mixtures far less violent and sudden in their action than fulminate of mercury.
3.—That the mechanical condition of the gun-cotton most materially influences the result, and that a considerable compactness or density, and a consequently great resistance to motion of the particles, is essential for the detonation of gun-cotton.

To what, then, is this remarkable action due? How comes it that the same substance is susceptible of a totally different metamorphosis into its gaseous products according to the manner in which fire is applied? Is it that the violence of explosion is proportionate to the amount of heat evolved in the disturbance of the chemical equilibrium of the particular substance used as a detonator? Is it due to the facility offered for the passage of heat throughout the mass of the detonating substance? Experiment does not support any one of these views. There is far more heat evolved in the combustion of 100 grains of sulphide of antimony and chlorate of potash than in the explosion of ten grains of mercuric fulminate; the latter, however, invariably detonates compressed gun-cotton, while the former fails to do so. It is impossible to detonate loose porous gun-cotton, so that the action cannot be due to the facility with which heat can permeate the mass. Both iodide and chloride of nitrogen, even in comparatively large charges, fail to detonate gun-cotton; yet the explosion of these substances is certainly far more sudden than mercuric fulminate. We must accordingly look elsewhere for an explanation of this extraordinary phenomenon, and recent experiments appear to favour the theory advanced by Mr. Abel, that the relative power of different explosive agents to accomplish the detonation of gun-cotton appears to be in direct proportion to the mechanical effects of their explosion—in other words, to the blow they are capable of inflicting on whatever body they may be in contact with.

When iodide and chloride of nitrogen are fired on a thin sheet of copper, the detonation produced by the explosion is not nearly so marked as in the case of

the mercury or silver fulminates. The indent produced by the former is not nearly so deep or sharply defined; indeed, a charge of two grains of chloride of nitrogen has been exploded on a watch-glass without fracturing it, whereas half that amount of silver fulminate was sufficient to shatter the glass to atoms. The mechanical effect of mercuric fulminate is much enhanced by confinement in a strong case, such as a tin tube, and under such conditions the violence of its action, as measured by work done, is in excess of either of the nitrogen compounds. This may probably account for the fact that, although more instantaneous in its action, iodide of nitrogen fails to detonate gun-cotton even in a charge 20 times greater than the usual charge of mercuric fulminate. Possibly further investigation may throw more light on this remarkable explosive property. There may yet become hidden peculiarity in the concussion or powerful vibration produced by some substances distinct from the mechanical force due to their explosion. There appears to be a species of *entente cordiale* between explosives of a certain class. They have a strange undefined sympathy with one another. If one goes off all the others in the immediate neighbourhood seem instantaneously to be in support. As the synchronous vibrations of a tuning-fork are taken up by other instruments, so the molecules of various explosives pulsate in unison. Thus, bodies in a state of high chemical tension may more readily yield to the influence of detonation, or at any rate, may prove more susceptible to the operation of mechanical force chemically applied.

These speculations, however, are more suited to a philosophical magazine than to our columns, and we shall now turn to a more practical theme—a short description of the principal operations during the past year in which compressed gun-cotton has performed an active part.

The value of this explosive for the speedy demolition of buildings was forcibly illustrated last summer in an experiment near Rye. A martello tower having been devoted to destruction, owing to the encroachment of the sea, 2000 lbs. of compressed gun-cotton were laid in a heap on the basement floor. A detonating fuse having been buried in the pile, the explosion was effected by means of electric agency. As a work of demolition this experiment was complete—the tower was utterly demolished. It has been calculated that over 1000 lbs. of gunpowder must have been employed to produce a similar result. The experiment was repeated in the spring of this year with equally satisfactory results.

The demolition of the old fortifications of Portsmouth offered many opportunities of testing the value of compressed gun-cotton for military purposes. Portions of the counterescarp were blown out with comparatively small charges, and in one instance a very strong counterescarp gallery of brick and stone, about 250 ft. long and 7 ft. wide, was destroyed by a charge of 60 lbs. of gun-cotton simply hung on nails to the roof at one extremity. The power of hastily demolishing buildings is frequently of great importance during the operations of both war and peace. Batteries may be constructed with secrecy and without annoyance when masked by buildings which at the proper moment may be demolished with great facility. During the fire at Quebec several buildings had to be blown down to arrest the progress of the flames; here gun-cotton would have been of signal service. No tamping, no excavation would have been required. A few pounds placed in the cellar, a wire rapidly run out for 100 yards or so, the turn of a handle, the pressure of a key, and the loftiest house would have toppled over and collapsed like a toy steepie.

The important experiments undertaken at Chatham by the Royal Engineer Committee proved conclusively the special value of compressed gun-cotton for military demolitions, such as stockades, bridges, piers, brick walls, &c. A wooden beam, 10 in. in diameter, was completely shattered by 2 cwt. of compressed gun-cotton fired in a hole bored in the wood. A strong upright pile of foreign deal, over 17 in. in diameter, snapped off like a carrot under the influence of a necklace of gun-cotton discs—80 lbs. of compressed gun-cotton was found sufficient to effect a complete breach through a double stockade formed of strong wooden piles, firmly bound together. The cotton was simply laid on the ground at the foot of one of the piles, and its explosion blew a passage sufficiently wide to drive a cart through. Brick walls of 18 in. thick can be destroyed in detail by a string of discs laid along the bottom of the wall. In all these operations the lightness of the material, the absolute security with which it was handled, the fact of its requiring no tamping, and the ease and rapidity with which it may be applied showed that compressed gun-cotton was admirably adapted for the service.

Let us now look at it as applied to naval purposes. The Torpedo Committee have demonstrated that compressed gun-cotton is over four times as powerful as gunpowder when used in torpedoes. To contain a charge of from 1600 lbs. to 2000 lbs. of gunpowder it was necessary to provide a large and comparatively unmanageable receptacle. By the employment of a fourth of the weight of gun-cotton, or from 400 lbs. to 500 lbs., the size of torpedoes has been reduced, and their service correspondingly facilitated. Such large charges, however, rarely find use except in torpedoes. For those of an active class, such as Harvey's or Whitehead's, 100 lbs. of compressed gun-cotton will probably be found to be ample. Compressed gun-cotton may, however, be the means of saving life as well as destroying it. The submerged rock, which costs the sailor many an anxious thought and sleepless night, rapidly disappears under the Titanic hammering of successive gun-cotton charges, and the preliminary experiments at Dover and Cardiff have pointed to the feasibility of thus removing many harbour obstructions.

With a view of demonstrating the non-explosive property of compressed gun-cotton when fired by the ordinary application of heat, a number of wooden boxes, each containing 25 lbs. of gun-cotton discs, were stacked on one another, and surrounded with similar boxes full of clay, so as to represent the weight of the superincumbent mass when the boxes were stacked in tiers, as they would be in store. An ordinary electric tube, having previously been inserted into one of the boxes of gun-cotton, was then fired. Many of the spectators, knowing what would occur in the case of gunpowder, were prepared for a violent explosion. To their astonishment, however, the gun-cotton of the individual box merely inflamed, without igniting that in the other boxes, and without disturbing the pile in any way. The experiment was then repeated by kindling a fire in the pile with shavings and tar. A considerable bonfire was the result. The outside of the boxes burnt bravely for some 10 or 15 minutes, until at length the flame found access to the gun-cotton in one of the boxes; this was followed by a dull puff and a bright mass of flame, but there was no explosion. The materials of the bonfire were then scattered by the artillerymen in charge, in doing which a box of gun-cotton, partially charred on the outside, inflamed while being dragged by one of the men over the incandescent debris. Had this been a barrel of gunpowder several lives would, in all probability, have been sacrificed; as it was the incident only caused a laugh at the agility with which the man jumped backwards. How, then, can we possibly explain the awful catastrophe at Stowmarket? Suddenly, unexpectedly, treacherously, a magazine of compressed gun-cotton explodes, dealing death and destruction on all sides.

The managers, trusting to the teaching of experiments, are sacrificed in their attempts to drag the boxes from the burning buildings. So far from merely inflaming the gun-cotton explodes with great violence, and a whole county vibrates to the shock.

It is known that no stone will be left unturned to get to the bottom of this dreadful event.

It is known that a large quantity of gun-cotton was stored on the premises.

About 12 or 15 tons of this former part of a contract in course of execution by Messrs. Prentice for Government. The balance consisted, it appears, of ordinary trade gun-cotton used for blasting and sporting purposes.

We believe this description of material does not undergo the same rigid tests as are applied to the Government supply. The inquest will probably enable us to determine whether any of this comparatively inferior gun-cotton was in the magazine when the explosion occurred.

It is possible that the heat of the weather may have decomposed and fired a box of small-arm or blasting cartridges, and that the rest of the gun-cotton may have been exploded by the mechanical concussion or blow thus produced.

It is hardly possible, but still it is possible, that a box of detonators may by some chance have got into one of the magazines, and that the accident is due to this. The enquiry, however, cannot be too searching.—Times.

FOREIGN MINING AND METALLURGY.

In the Meurthe and the Moselle great firmness is noted in refining pig, which remains between 27. 16s. 10d. and 27. 15s. 4d. per ton. The blast furnaces extinguished in this part of France are about to be re-lighted; the Rehon Works have set the first example in this respect. In the Ardennes the production of iron is being resumed upon a considerable scale. The Vireux Works have now 20 puddling furnaces in activity, and arrangements are being made for a still further extension of the production. In the Franche-Comté district prices are not very clearly defined, the foremasters not being able to establish regular quotations. Communications are difficult, if not impossible, and transactions are concluded according to the special circumstances of buyers and sellers. The advices received from the Haute-Marne show great dullness in affairs. Orders for Paris are somewhat falling off, and the provincial demand requires the complete re-establishment of railway goods traffic to bring it up to its old level. Refining pig has been selling in the Haute-Marne at 47. per ton, and pig for re-casting purposes at 47. to 47. 8s. per ton. There is comparatively little demand for puddled iron from coke-made pig; prices range from 87. 16s. to 97. 12s. per ton. Rolled iron from charcoal-made pig remains at 107. 12s. to 107. 16s. per ton. A good demand prevails for axes. Merchants' bars have made 117. 4s. to 117. 8s. per ton; axes, 117. 4s. to 117. 12s. per ton; finished axes, 47. 8s. to 57. 4s. per ton additional; sheets, first category, 107. 16s. to 117. 4s. per ton. First-class special iron has made 97. 12s. to 107. per ton. The Marival forge, established by M. Roger Houzelot, has been in operation for the last two months. M. Desforges is commencing also in the same neighbourhood the construction of a furnace of large dimensions intended to be devoted to the production of refining pig. Coke-made iron is now 16s. per ton, and charcoal-made iron 17. 4s. per ton, dearer at Paris than before the war; it is difficult, however, to establish quotations with precision, owing to the difficulty of communications and the want of rolling-stock.

At Havre the price of copper has experienced a slight fall, and although an official quotation of 727. per ton is still given, it would be easy to obtain the best marks at 717. 8s. per ton. Some lots of special marks have changed hands at 697. 8s. per ton, Paris conditions. Prices have not varied at Marseilles. In Germany the copper markets have presented a more animated appearance, and it is expected that the autumn will witness a more active trade. In Holland the price of copper has remained about stationary. There has been no variation in tin at Marseilles. The German tin markets have shown considerable firmness. The Rotterdam tin market has been very quiet; Banca has been offered at 807. 8s., and Billiton at 797. 8s., without finding purchasers. France has made large imports of tin

in anticipation of heavy import duties, so that the French demand is now expected to fall off. There is scarcely any change to report in lead or zinc.

There is no notable change to record in the position of the Belgian iron trade, orders are sustained for iron and pig of all qualities, and prices are well supported; in plates there is even a slight advance. The mechanics of Verviers have succeeded in carrying a reduction in their hours of labour to ten hours per day. The La Croyère rolling-mill has been sold for the comparatively small sum of 6000l., to M. Emile Sirant, banker, of Mons. The imports of minerals and limailles into Belgium in May are shown by the official tables to have been 50,755 tons, against 66,811 tons in May, 1870; in the first five months of the year the aggregate imports were 233,245 tons, against 269,605 tons in the corresponding period of 1870. The total imports of rough pig and old iron into Belgium in May were 7340 tons, against 5242 tons in May, 1870; in the first five months of this year the aggregate imports were 27,218 tons, as compared with 36,419 tons in the corresponding period of 1870. The whole imports of iron of various kinds into Belgium in May, exclusive of minerals and limailles, amounted to 8093 tons, against 6982 tons in May, 1870. The exports of minerals and limailles from Belgium in May amounted to 17,284 tons, against 19,945 tons in May, 1870; and in the first five months of this year to 59,360 tons, against 74,015 tons in the corresponding period of 1870. The exports of rough pig and old iron from Belgium in May amounted to 2593 tons, against 608 tons in May, 1870; and in the first five months of this year to 11,544 tons, against 2710 tons in the corresponding period of May, 1870. The exports of rails from Belgium in May amounted to 9644 tons, against 15,794 tons in May, 1870; in the first five months of this year the exports of rails from Belgium were only 25,536 tons, against 50,617 tons in the corresponding period of 1870. The exports of plates from Belgium also show a decrease, having amounted to May 31 this year to 6067 tons, against 9321 tons in the corresponding period of 1870. To sum up, it may be observed that the exports of iron of every description from Belgium to May 31 this year were 79,884 tons, against 106,267 tons in the corresponding period of 1870.

In the basin of the Couchant de Mons the coal trade remains without any notable change. There is still great complaints, however, as to the want of rolling-stock on the Northern of France, the Eastern of France, and the Belgian State Railways. Prices of coal remain without change, but freights are rising. Coke is in active demand, in consequence of the re-lighting of the furnaces of the German Moselle and those of the Longwy basin, as well as the approaching lighting of new furnaces in the Grand Duchy of Luxembourg. Orders continue to flow in freely in the Charleroi basin. Coking coal sells readily at 10s. 6d. per ton; coke also sells easily at 15s. 2d. per ton. The production of agglomerates fails to keep pace with the demand. In the Léige basin the extraction is being actively carried on; producers, however, display great prudence with reference to future engagements. Coke is in good demand at an advance. The imports of coal into Belgium in the first five months of this year were 78,454 tons, against 82,627 tons in the corresponding period of 1870; the imports of coke were 796 tons, against 4917 tons. The exports of coal from Belgium in May were 280,465 tons, against 322,628 tons in May, 1870. In the first five months of this year the exports were 1,056,417 tons, against 1,511,593 tons in the corresponding period of 1870. The exports of coal from Belgium to the Zollverein and the Low Countries largely increased in the first five months of this year; the exports to France presented a decrease, however, of more than 578,000 tons. The exports of coke from Belgium in the first five months of this year were 154,112 tons, against 303,382 tons in the corresponding period of 1870.

FOREIGN MINES.

ST. JOHN DEL REY (Gold).—Morro Velho, July 17: Produce for June 10,607 ozt., from 4217 tons ore, yield 2,490 ozt. per ton; cost for June, 4802l.; loss, 573l. Produce 11 days of July, 4050 ozt., yield 2,351 ozt. per ton. The sinking in the new shaft during the first fortnight of July has been very small, owing to our supply of dynamite being exhausted. A fresh supply had arrived at Rio de Janeiro, and been forwarded to the mines, where it would probably arrive in time to conduct the August operations with.

DON PEDRO (Gold).—Mr. F. S. Symons reports for June:—Produce, 14,414 ozt., at 8s. 6d. per oztava, 61257. 19s.; cost, 25757. 15s. 6d.; profit, 25507. 3s. 6d. I am pleased to report the produce is the best we have had for some time, and enables a fair profit to be shown, notwithstanding an exceptional price for gold. Box work has been taken from three different points—No. 6, the Curvo, and Canoa; but one of the most pleasing and important features that I have to report is the great improvement at Alice's west section, in a short of lode at eastern extremity making under level, and which bids fair to show one that will yield good returns for some time. Surface works have been vigorously pushed on, particularly that in connection with permanent pumping machinery. House for three captains completed; the one formerly occupied by same will be cleaned and repaired for company's surgeon.—First Division of July: Extract from Mr. F. S. Symons's letter, dated July 17: Produce weighed to date, 5518 ozt. The mine works progressing in a steady satisfactory manner. Lode treated has been principally derived from Alice's west and No. 6, rising from horizon of old sump; both sections have given box-work. Little ground has been excavated from either the Curvo or Canoa, but level from the 25 cross-cut, for more effectually draining the northern ground, is progressing favourably. Auriferous ground has been struck in adit level, supposed to be No. 8. Middle adit going on fairly. Force has been increased, and three crews are now working. Another cross-cut has been commenced at the Mateo Cobras, north and west of the present, and at higher horizon. Both here and at Tambor the explorations are being carried on with regularity.

GENERAL BRAZILIAN (Gold).—Capt. T. Treloar reports for June:—I have pleasure in stating that all matters on this side are proceeding well. But on your side nothing, I fear, in the absence of produce will be received as satisfactory. I am, of course, sorry for this, but I feel quite easy that the results eventually will gratify the bona fide shareholders, and be creditable to me. All I have written, and all I have done, will bear the strictest investigation; but, like hundreds before me, it is my misfortune at present to be underestimating and deceived. The day, however, is surely not far distant when matters will be reversed. All measures for re-opening these great mines, and exploring new ground, have received careful consideration; no difference of opinion exists, and the course decided upon is recorded in the mine conference book.—First Division of July: Extract from Capt. Treloar's letter, dated July 15:—Everything continues to progress satisfactorily. At St. Anna a road has been laid down at the shallow adit, and 2 fms. driven. At Itabira a stamping-mill has been worked sufficiently to retain legal possession of the mine.

ANGLO-BRAZILIAN (Gold).—Mr. F. S. Symons reports for June:—Produce for the month amounts to 636 ozt. (or 73 cwt. Troy); total cost for the month, including that at Pitangue, 1877. 18s. Stone treated from the Fundao section has been poor, no amelioration having taken place in the standard. With reduced force, explorations for the Vieira will still be carried on. Course Fundao west, Foster's section, has been continued; no difference of opinion exists, and the course decided upon is recorded in the mine conference book.—First Division of July: Extract from Capt. Treloar's letter, dated July 15:—Everything continues to progress satisfactorily. At St. Anna a road has been laid down at the shallow adit, and 2 fms. driven. At Itabira a stamping-mill has been worked sufficiently to retain legal possession of the mine. With reduced force, explorations for the Vieira will still be carried on. 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